

REMARKS

This amendment is submitted in response to Office Action mailed on February 13, 2008, in which pending claims 1-5, 8, 10, 11, 16, 18-23, 27, 28, 33, and 36-42 are rejected. With this amendment, claim 1 is amended. Accordingly, claims 1-5, 8, 10, 11, 16, 18-23, 27, 28, 33, and 36-42 are presented for reconsideration and allowance.

I. Response to rejections of claims 1-3, 8, 10, 11, 16, 18, 21, 22, 27, 28, and 33

In the Office Action, claims 1-3, 8, 10, 11, 16, 18, 21, 22, 27, 28, and 33 are rejected under 35 U.S.C. § 103(a) as being obvious over statements recited in the specification and Crump et al., U.S. Patent No. 5,121,329 (“the Crump ‘329 patent”) in view of Joseph et al., U.S. Patent No. 3,807,054 (“the Joseph ‘054 patent”) or Edmonds, U.S. Patent No. 5,448,838 (“the Edmonds ‘838 patent”). In particular, the Office Action states that it is extremely well known in the art that thermoplastic object surfaces formed as having a surface roughness may be smoothing by exposing the object to vapors of a solvent such as methylene chloride that transiently softens the thermoplastic material at the object surface and reflows the softened thermoplastic material to uniformly smooth the object surface. Based on this contention, the Office Action states that it would have been obvious to one skilled in the art at the time the invention was made to smooth the object surface using vapors of a solvent.

In response, claim 1 is amended to further recite that at least a portion of the object surface has a surface effect due to the layered manufacturing rapid prototyping technique, and reflowing the softened modeling material to smooth the surface effect of the object surface. Similarly, independent claim 21 recites forming a plurality of layers with a modeling material using a layered manufacturing rapid prototyping technique to build an object having an object surface, where the plurality of layers create a surface effect at the object surface, the surface effect being selected from the group consisting of a stair step effect, a roughness, and a combination thereof. Accordingly, as recited in claims 1 and 21, the surface effects of the object surfaces (e.g., stair step effect) are due to the layered manufacturing rapid prototyping techniques used.

The Crump ‘329 patent, the Joseph ‘054 patent, and the Edmonds ‘838 patent, taken alone or in combination, however, do not disclose or suggest that surface effects due to the

layered manufacturing rapid prototyping technique used (e.g., stair step effects), such as the technique disclosed in the Crump '329 patent, may be smoothed or reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material. The Joseph '054 patent and the Edmonds '838 patent merely disclose systems and processes for smoothing the surfaces of plastic articles with solvent vapors, and do not suggest that the surfaces of the plastic articles have surface effects due to the layered manufacturing rapid prototyping technique used. In fact, as discussed below, Leyden et al., U.S. Patent No. 5,143,663 ("the Leyden '663 patent"), which involves a layered manufacturing rapid prototyping technique, illustrates that the vapor smoothing technique disclosed in the present application is not suitable for all forms of layered manufacturing rapid prototyping techniques.

The only teaching of the use of a vapor smoothing technique for reducing a surface effect in an object built with a layered manufacturing rapid prototyping technique is found in teachings of the present application. Thus, there is no teaching in the art of record that discloses or suggests the inventions recited in amended claim 1 and claim 21. Accordingly, claims 1 and 21 are not obvious over the Crump '329 patent in view of the Joseph '054 patent and/or the Edmonds '838 patent, and are allowable.

Claims 2-5, 8, 10, 11, 16, 18-20, 22, 23, 27, 28, and 33 depend respectively from claims 1 and 21, and are allowable therewith. In addition, it is respectfully submitted that the combinations of features recited in claims 2-5, 8, 10, 11, 16, 18-20, 22, 23, 27, 28, and 33 are independently patentable, although this does not need to be specifically addressed herein since any claim depending from a patentable independent claim is also patentable. See M.P.E.P. 2143.03, citing *In re Fine*, 5 U.S.P.Q.2d (BNA) 1596 (Fed. Cir. 1988).

II. Response to rejections of claims 4, 5, and 23

In the Office Action, claims 4, 5, and 23 are rejected under 35 U.S.C. § 103(a) as being obvious over statements recited in the specification and the Crump '329 patent in view of the Joseph '054 patent or the Edmonds '838 patent, and further in view of Dahlin et al., U.S. Patent No. 6,022,207 ("the Dahlin '207 patent"). As discussed above, the Crump '329 patent, the Joseph '054 patent, and the Edmonds '838 patent, taken alone or in combination,

do not disclose or suggest the invention recited in claim 1 or claim 21. Furthermore, the Dahlin '207 patent also does not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in the Crump '329 patent, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material. Accordingly, claims 1 and 21 are not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Dahlin '209 patent and are allowable. Correspondingly, claims 4, 5, and 23, which respectively depend from claims 1 and 21, are not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Dahlin '209 patent for the same reasons, and are allowable.

III. Response to rejections of claims 19, 20, 36-39, 41, and 42

In the Office Action, claims 19, 20, 36-39, 41, and 42 are rejected under 35 U.S.C. § 103(a) as being obvious over statements recited in the specification and the Crump '329 patent in view of the Joseph '054 patent or the Edmonds '838 patent, and further in view of the Leyden '663 patent. In particular, the Office Action states that the Leyden '663 patent discloses that the object is built oversized such that after the surface roughness is removed, the object will be the right size.

As discussed above, the Crump '329 patent, the Joseph '054 patent, and the Edmonds '838 patent, taken alone or in combination, do not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used (e.g., stair step effects), such as the technique disclosed in the Crump '329 patent, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material.

Furthermore, the Leyden '663 patent does not disclose exposing an object (built with a layered manufacturing rapid prototyping technique) to vapors of a solvent that transiently softens modeling material at a surface of the object, or reflowing the softened modeling material to reduce surface effects of the object surface. The layered manufacturing rapid prototyping technique disclosed in the Leyden '663 patent is a stereolithographic process, which involves building an object in a layer-by-layer manner from a liquid

photopolymerizable resin ('663 patent, col. 1, lines 34-61). Layers of the photopolymerizable resin are cured (i.e., crosslinked) upon exposure to synergistic stimulation (e.g., an ultraviolet laser beam), thereby forming the solidified layers of the object ('663 patent, col. 1, line 62 to col. 2, line 18).

As shown at col. 6, lines 4-38 of the Leyden '663 patent, after the object is built with a stereolithographic process, the object undergoes a post processing operation, which includes absorbing/cleaning the residual uncured resin from the object (steps 3-5), and subsequently performing a surface smoothing process (steps 6-12). While the Leyden '663 patent does disclose exposing the object to a solvent vapor, the exposure is used to clean the residual uncured resin from the surface of the object prior to the surface smoothing steps ('663 patent, col. 6, lines 56-68; col. 9, lines 34-39; and col. 11, lines 35-44). In particular, the Leyden '663 patent discloses that the object is cleaned with a solvent to remove the excess resin ('663 patent, col. 6, lines 56-68; col. 9, and col. 11, lines 35-44), and is then subsequently smoothed to remove surface discontinuities (e.g., stair step appearances and rough surface finish) ('663 patent, col. 7, lines 1-15). However, the smoothing process does not involve the use of a solvent vapor. Instead, the surface of the object is coated with an additional amount of resin to fill in the surface discontinuities, and the additional amount of resin is then cured to provide a smooth, solid surface ('663 patent, col. 7, lines 1-15).

Accordingly, exposing the cured resin of the object to a solvent vapor does not cause the cured resin to transiently soften and reflow to smooth the surface of the object as required by claim 1 of the present application. This is because the stereolithographic process disclosed in the Leyden '663 patent uses a photopolymerizable resin for the modeling material. It is general knowledge in the art of photopolymerizable materials that curing (i.e., crosslinking) such materials substantially decreases the solubility of the materials in solvents. Because the cured resin disclosed in the Leyden '663 patent has a low solubility in solvent vapors, exposure to the solvent vapor does not soften the cured resin at the surface of the object, and does not allow the cured resin to reflow. Thus, the photopolymerizable resin used to build the object in the Leyden '663 patent is not suitable for the vapor smoothing process of the present invention. This is why the Leyden '663 patent discloses the use of a subsequent smoothing process (i.e., applying and curing an additional amount of the curable

resin to fill in the surface discontinuities).

Furthermore, modeling materials that transiently soften and reflow upon exposure to a solvent vapor (e.g., thermoplastic materials) are not suitable for use in building an object with the stereolithographic process disclosed in the Leyden '663 patent. In particular, such materials are not cured in a stereolithographic process to provide a solid object. Thus, the vapor smoothing processes disclosed in the Joseph '054 patent or the Edmonds '838 patent are not suitable for reducing surface effects due to the stereolithographic process disclosed in the Leyden '663 patent.

As a result, claim 1 is not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Leyden '663 patent and is allowable. Correspondingly, claims 19 and 20, which depend from claim 1, are not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Leyden '663 patent for the same reasons, and are allowable.

With respect to claims 36-39, 41, and 42, independent claim 36 recites building an object as defined by a modified object representation from a modeling material using a layered manufacturing technique, and vapor smoothing surfaces of the object to produce a finished object, where the finished object having a surface geometry that approximately matches that of the initial object representation. As discussed above, the vapor smoothing processes disclosed in the Joseph '054 patent or the Edmonds '838 patent are not suitable for smoothing surfaces of 3D objects built with the stereolithographic process disclosed in the Leyden '663 patent. In particular, due to the crosslinking that occurs with a stereolithographic process, vapor smoothing is not a suitable technique for producing a finished 3D object from an object built with the stereolithographic process and having a modified object representation.

As a result, claim 36 is also not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Leyden '663 patent and is allowable. Correspondingly, claims 37-39, 41, and 42, which depend from claim 36, are not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Leyden '663 patent for the same reasons, and are allowable.

IV. Response to rejection of claims 40

In the Office Action, claim 40 is rejected under 35 U.S.C. § 103(a) as being obvious over statements recited in the specification and the Crump '329 patent in view of the Joseph '054 patent or the Edmonds '838 patent, and the Leyden '663 patent, and further in view of the Dahlin '207 patent. As discussed above, claim 36 is not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, and/or the Leyden '663 patent, and is allowable. Furthermore, the Dahlin '209 patent does not disclose building an object as defined by a modified object representation from a modeling material using a layered manufacturing technique, and vapor smoothing surfaces of the object to produce a finished object, where the finished object having a surface geometry that approximately matches that of the initial object representation. As such, claim 36 is also not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, the Leyden '663 patent, and/or the Dahlin '207 patent. Correspondingly, claim 40, which depends from claim 36, is not obvious over the Crump '329 patent in view of the Joseph '054 patent, the Edmonds '838 patent, the Leyden '663 patent, and/or the Dahlin '207 patent for the same reasons, and is allowable.

CONCLUSION

Because the prior art made of record does not disclose or suggest all the elements in claims 1-5, 8, 10, 11, 16, 18-23, 27, 28, 33, and 36-42, pending claims 1-5, 8, 10, 11, 16, 18-23, 27, 28, 33, and 36-42 are in condition for allowance. Favorable reconsideration and allowance of this application are respectfully requested.

Respectfully submitted,

KINNEY & LANGE, P.A.

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By: /Brian R. Morrison/
Brian R. Morrison, Reg. No. 58,455
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580